Africa and Technology in Higher Education: Trends, Challenges, and Promise

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Abstract

Showing that technology in higher education in African countries is lagging behind the developed world and also that Internet connectivity is on the rise in African nations, this paper describes and analyzes trends in the use of ICTs as well as the impact that the shortage in technological use and capacity has on Africa, particularly that needed to address the changing demands within the higher education sector. Challenges to the proposed widespread implementation of technology exist, particularly because most institutions of higher education have very limited technological capacity and basic resources, such as electricity, equipment, and funding; brain drain, improper use of ICT, and the colonial mindset are also factors. It is suggested that ICT be integrated into education with a purpose and within the context of postcolonial theory and a critical pedagogy perspective. Key uses of ICT in education, including mobile technology, are access, support, and communication, making learning available to anyone anywhere and enhancing learning as an interactive process, with much potential for collaboration and problem-solving. Four salient components related to incorporating ICTs into higher education are discussed: (a) teacher education; (b) curriculum; (c) distance learning; and (d) educational policy, planning, and management. Examples of technological initiatives in higher education as well as recommendations are given. Ghana, Kenya, and Tanzania, representative of other African nations to varying degrees, are highlighted in regard to ICT infrastructure and its relevancy to higher education. It is concluded that African higher education has high potential for catching up in the technological race.

Key words: ICT (information and communication technology) in Africa, higher education, African technology, distance learning, postcolonial theory, critical pedagogy.

Discussion of the state of higher learning and technology in Africa in comparison to developed countries is of great interest and import. All indications suggest that technology in higher education in African countries as a whole is lagging behind compared to the developed world. Of the approximately 1.1 billion people living in Africa (Internet World Stats, 2014), only 200 million own radios (UNESCO, 2002), 24 million own cellular phones, 20 million have a fixed phone line, 5.9 million own personal computers, and 1 in 13 households have

television access (United Nations Information and Communication Technologies Task Force, 2002 as referred to in Gebremichael & Jackson, 2006. Moreover, most institutions of higher education in Africa continue to struggle to survive with only very limited technological capacity and basic resources, such as electricity, equipment, and funding. In the context of higher education, African computer laboratories are typically infrequently accessed, housing old and broken computers, with few or no educational programs installed on them (Unwin, 2005). Such limited technological infrastructure in Africa is making it hard for institutions to achieve their educational objectives.

African scholar, Diallo (n.d.), Director of the United Nations Educational, Scientific and Cultural Organization (UNESCO), has written of her passion for technology in African higher education, but painted a picture of why the discussion of technology and learning in Africa is somewhat of a paradox when it comes to information and communication technologies (ICTs), such as electronic mail, World Wide Web, learning management systems (e.g., Blackboard and WebCT), and computer conferencing. Specifically, she highlights the fact that folks in the rural areas of Africa cannot even afford access to something as basic as electricity, thus how can they be expected to effectively compete with advanced countries in terms of technological advancement? Diallo contended that it is not possible for the technologies that exist in the developed world to have a place on the African continent in its present condition. In the Director's words, "Most technologies, electronic networks, computers, etc. are far beyond the reach of the majority of [citizens]" (p. 1). Indeed, only 7% of the world's internet users live in Africa (Internet World Stats, 2014). Possible contributors to this state of affairs include inadequate resources, the lack of technological infrastructure, and unreliable electricity provision, among other factors.

This "inequality in access, distribution, and use of information and communication technologies between two or more populations'' (Wilson, 2006, p. 300) is known as the digital divide (Fuchs & Horak, 2008). This digital divide involves material access (physical access to ICTs), mental access (ICT experience), skill access (information and strategic skills in ICT use), and usage access (meaningful opportunities for using ICTs) (Van Dijk & Hacker as referred to in Fuchs & Horak, 2008). In Africa, material access to ICTs in higher education is limited, because African institutions, educators, and students cannot afford it, and following from this, experience, skills, and opportunities to use ICTs are also lacking. The situation is so severe that the digital divide has been called the digital apartheid in reference to Africa, due to this continent's systematic exclusion from technological progress and its accompanying benefits (Fuchs & Horak, 2008). The digital divide also exists domestically, with African cities having higher levels of ICT development and access than African rural areas (Gebremichael & Jackson, 2006).

In the context of education, the digital divide has been referred to as the worldwide crisis in education. Specifically,

> Since 1945, all countries have undergone fantastically swift environmental changes, brought about by a number of concurrent worldwide revolutions in science and technology, in economic and political affairs, in demographic and social structures. Educational systems have also grown and changed more rapidly than ever before. But they have adapted all too slowly in relation to the faster pace of events on the move all around them. The consequent disparity—taking many forms—between educational systems and their environments is the essence of the worldwide crisis in education. (Coombs as cited in Shrestha, 1999, p. 1)

The Africans are behind in this technological race related to both developing as well as applying technology to higher education. However, rapid progress in technology innovations, which is again revolutionizing the capacity to store, transmit, and use information, is imminent in nations across Africa (Salmi, 2002). In fact, extending access to, and strengthening the quality of technology in higher education in Africa is emerging as a key national priority of African governments, as is the case on national agendas throughout the

developing world (Chapman & Austin, 2002). The current debate as to "whether technology alone can strengthen African education" ("Africa," 2009, para. 13) remains to be seen and discussed.

Nevertheless, with the advent of ICT, many scholars believe there is still hope for Africa in partnership with the developed world (Ochieng, 2006). Diallo (n.d.) pointed out that certain technologies, such as radio and TV, are already in place, which "if channeled properly, can and do work in favour of the people and perhaps it is on these that we should build our technological base" (p. 1). Further, Bheki Khumalo, Director of Corporate Affairs at Siemens Southern Africa, contended that Africa can "fight poverty and increase access to education and health care using the information infrastructure technology" (as cited in Ochieng, 2006, p. 3). For the first time, Africans are having access to digital technology (Brown, 2003; Marek, n.d.), which in time, can lead to a cultural revolution in Africa (Khumalo as referred to in Ochieng, 2006). Fueling this hope, the statistics on Internet usage for the individual countries in Africa from 2000 to 2007 indicate enormous user growth across the board. A good example is the Democratic Republic of the Congo, where the number of internet users jumped from 500 to 180,000 between 2000 and 2007 (Miniwatts Marketing Group as cited in "Ghana," n.d., p. 23).

Regardless of what is being said in the press, Africa has a long history of the use of technology of one kind or another for higher education purposes. In addition, Africa has over 15 years' worth of experience in ICT development, implementation, evaluation, training, and policy development, both in institutions and at the national level (Kaapanda, 2013). In the present, there continue to be numerous ICT initiatives being developed and implemented (Unwin et al., 2010); however, despite the variety of ways in which ICTs are currently being used in Africa's education system, their use is still in the early stages (Unwin, 2008). Indeed, according to one survey, most educators are using ICTs in the form of accessing information on the internet and for communication purposes (i.e., e-mail) (Unwin, 2008), rather than as a component of teaching. It is interesting to note that some scholars think the presence of technology in Africa is a power goal in its own right, and that "simply introducing technological innovation will have a beneficial effect on education across the Africa continent" ("Africa," 2009, para. 14). However, Former British Parliamentarian, Dr. Harold Elletson, voiced the concern that "technology can only be part of a wider solution, and a concentration on technological change can lead to a failure to develop other more basic infrastructure" (as cited in "Africa," 2009, para. 14). Indeed, Unwin argued that on the one hand, oftentimes these initiatives fail due to a lack of consideration of the current infrastructure and the needs of the intended users (Unwin et al., 2010). For example, such initiatives must take into consideration the impact of unstable electricity provision, high internet access costs, and bandwidth limitations (Unwin et al., 2010) in their development in order to succeed. On the other hand, Unwin (2008) posited,

> It might not so much be the "hard" infrastructural constraints that are holding back the expansion of e-learning in Africa, but rather the "softer" dimensions of management, training, and the development of appropriate levels of expertise in e-learning design that are the most important factors that require attention. (p. 9)

Within a global context, the issues facing educational pedagogies in Africa are not solely related to technology; there are clearly other salient issues in general. However, this essay is focused solely on exploring the integration of technology into higher education and how this is currently being done. Accordingly, the purpose of this paper is to describe and analyze trends in the use of ICTs as well as the impact that the shortage in technological use and capacity has on Africa, particularly the technology needed to address the changing demands within the higher education sector. Among some positive dynamics, this paper makes note of the following points, as described by McCann, Christmass, Nicholson, and Stuparich (1998): (a) the emphasis on technology as a more flexible mode of learning, (b) the use of technology for facilitating the extension of university services to national and international markets, and (c) the use of technology as a more practical form of delivery of higher education in terms of access and cost effectiveness in an increasingly competitive environment.

Benefits of ICT Use in African Higher Education

A basic part of the ongoing debate in Africa is whether or not it is necessary or a priority to invest in using ICTs in educational settings in Africa (Butcher, 2009). Research from the University of Sheffield pointed out that even 10 to 20 years ago when computer technology was in its infancy, it was widely recognized that "computer-aided learning could bring about advances in educational quality" (McCann et al., 1998, p. 17). Therefore, this statement should still hold true now that computer technology is more advanced. The issue then is not so much *whether,* but *why* it is necessary or a priority to invest in using ICTs in African higher education to meet the educational needs of its population and help solve educational challenges.

From this standpoint, the application of ICT to higher education could and should be done immediately in order to form a broader range of strategies to make the education system more "productive and more efficient, regardless of how well or poorly resourced they [institutions of higher learning] might currently be" (Butcher, 2009, p. 2). And of great import, it has been recommended that the application of ICT to the teaching and learning process in African higher education be guided by "an understanding of effective learning conditions" (Taylor as cited in McCann et al., 1998, p. 17). Technology will only be beneficial when it can bring about various opportunities and challenges to higher education to enhance the quality of learning as well as accessibility and cost effectiveness in terms of knowledge delivery.

The key uses of ICT in education are access, support, and communication, according to Ochieng (2006). In regard to access, the use of ICTs can make learning available to anyone, at any time, and in any place. With the use of ICT in the delivery of knowledge and skills, the classroom is no longer limited to a physical space but rather is extended to become what is referred to as a virtual classroom, "distinguished by an open collaborative learning environment" (McCann et al., 1998, p. 17). In this way, ICTs enable larger numbers of students to engage in learning and complete university-level courses (Unwin, 2008), provide opportunities for students to study part-time and off-campus (Unwin et al., 2010), and make it possible for distance education students to engage in aspects of learning that were previously unavailable to them (Unwin et al., 2010). In addition, the use of ICTs increases student access to high quality international educational resources (Unwin et al., 2010). For example, internet access enables students to freely access websites all over the world, which can help facilitate their learning.

The use of ICTs for support and communication purposes serves to enhance learning as an interactive process, such as between the teacher/lecturers and students/learners and among the learners themselves (Kristiansen as referred to in Brown, 2003). This process will also strengthen the contact between the academic staff of institutions of higher learning and the students (Butcher, 2009; McCann et al., 1998; Shrestha, 1999), with much potential for collaboration and problem-solving on many levels (Kristiansen as referred to in Brown, 2003; Ochieng, 2006), building on Freire's (2006) ideology of the student-teacher relationship (referred to later on). Moreover, technology can easily be applied in higher education in a variety of ways "to support an almost endless combination of teaching and learning strategies, and it is essential to keep options as open as possible" (Butcher, 2009, p. 1).

The role of m-learning in the future of e-learning in Africa cannot be easily ignored (Brown, 2003; Butcher, 2009; Stevens, n.d.). *E-learning* is a macro concept that refers to any form of electronic transfer of knowledge and/or skills and encompasses both online and mobile learning environments (Brown, 2003). *M-learning*, or mobile learning, is a form of e-learning; it is "an emerging concept as the development of and adoption rate of mobile technologies increase rapidly on a global scale" (Brown, 2003, p. 1), and Africa represents the untold story of taking advantage of this modern technology. In fact, the adoption rate of mobile technologies in Africa's developing countries is among the highest rates globally (Brown, 2003).

In regard to how ICT can be used in addressing the challenges facing higher education in Africa, Brown (2003) pointed out that the relevance of m-learning for African higher education "lies in the fact that the majority of learners in Africa are without infrastructure for access" (p. 1). In this sense, the role that e-learning (and m-

learning in particular) plays in the learning process in higher education in terms of communication and interaction represents a critical success factor in contemporary educational paradigms, such as social constructivism (Brown 2003; Ochieng, 2006; Shrestha, 1999).

Theoretical Considerations Related to Inclusion of ICT in Higher Education

In order to begin to understand the current state of technology in higher education in Africa, and in turn, how to incorporate changes, it is essential to take into consideration the legacies of the structures of colonialism put in place by the colonizers. Such legacies, which have penetrated the structure, curriculum, and pedagogy of postcolonial Africa, continue to hold great powers of domination over much of Africa, resulting in a severe impact on the education of the African nations (Atteh, 1996; Chrisholm & Leyendecker, 2008; Mellow & Katopes, 2009; Sackey & Mahama, 2010). To this end, postcolonial theory, combined with a critical pedagogy perspective, has been chosen as the lens through which to view this present discourse on inclusion of technology in higher education in Africa.

Postcolonial Theory-Critical Pedagogy Lens

Both postcolonial theory and the critical pedagogy theoretical perspective rest on the vision of transformation (Farr, 2009; Freire, 2006; Roderick, 1986), making them highly applicable as theories for change in higher education in Africa. In effect, postcolonial theory "introduces racial and cultural dimensions into the analysis" (Childs & Williams, 1997, p. 22) and provides guidance for coming to grips with the mindset posed by Africa's colonial heritage in the postcolonial era, especially in terms of its damaging effects on higher education, with its disregard for the unique indigenous needs and culture of the African people (Armooh, 2007; Atteh, 1996; Atuahene, 2008; Sackey & Mahama, 2010).

Greatly influenced by Freire (2006), renowned for his attack on the banking concept of education, critical pedagogy is particularly concerned with changing or transforming the traditional student-teacher relationship. In the banking concept, the student is conceived of as an empty receptacle to be filled solely by the teacher—the one who knows (Freire, 2006). Accordingly, critical pedagogy can be considered particularly relevant in overcoming postcolonial influences when exploring changes in structure, curriculum, and pedagogy.

For example, in regard to pedagogy, education in Africa is still mostly geared towards the "prevalence of traditional and outmoded styles of teaching using chalk and talk as a teaching tool" (Vrije Universiteit, Amsterdam report as cited in Chrisholm & Leyendecker, 2008, p. 197). In this scenario, the expansion and appropriate use of technology in higher education, as examined through the lens of critical pedagogy, could revolutionize traditional learning, particularly in terms of the student-teacher relationship. And regarding curriculum, the use of this theoretical perspective can be instrumental in addressing two important questions implied earlier in this discourse: "[Are] African countries running the type of education technology needed to develop the continent or will the Western education do that for us?" (Alaneme, 2001, p. 1) and, Should Africans adopt a pick-and-choose attitude when it comes to the content and capabilities of digital technology? (Ochieng, 2006). In the end, viewing this discourse on technology in higher education in Africa through the lens of postcolonial theory and critical pedagogy can help with an understanding of why the quality of education in postcolonial Africa is behind other continents; how to transform students into interactive, creative learners as opposed to mere recipients of knowledge (Freire, 2006); and what needs to be changed to reflect the unique educational, cultural, and market needs of the people of each African country.

Practical Considerations Related to Inclusion of ICT in Higher Education

Although ICTs can greatly benefit Africans, as outlined above, there is also the potential to cause harm. Diallo (n.d.) viewed technology as a double-edged sword: "We in Africa can't accept it wholeheartedly without calling into question many of its pitfalls" (p. 2). Diallo saw resistance to change as hard to overcome, and argued that sometimes "technologies can also exacerbate frustrations" (p. 1). She gave, as an example, the scenario of the Internet being used as a vehicle of racist or socially unacceptable propaganda, or as a means of manipulating the poor. The Global Alliance for ICT and Development (GAID) has replicated Diallo's concerns, recognizing the potential for harm within the country:

> ICT can increase existing social and economic inequalities, particularly if access and use of ICTE [ICT for education] is not equally available to everyone. Implementation of ICTE must be case specific and locally driven, or the development community may risk further isolating impoverished populations rather than promoting inclusion and social advancement. (Gutterman, Rahman, Supelano, Thies, & Yang as cited in Gudmundsdottir, 2010, p. 178)

Diallo concluded, "So what is needed…is a sense of purpose" (p. 2)—the purposeful use of technology as a vehicle for educational messages, helplines, and the transmitting of vital information, rather than keeping it in the hands of a few, for selfish reasons. Applicable to humanity at large, she posited that "technology will only be beneficial to mankind if it is used to help bring men and women closer, if it speaks of peace, learning, and understanding amongst nations" (p. 2). Further, Ghanaian scholar Gyekye argued that ideally, "[technology] should rise from the culture of people, if it is to be directly accessible to a large section of the population and its nuances are to be fully appreciated by them" (as cited in Gudmundsdottir, 2010, p. 174).

Many ICT initiatives have been developed in the developed world and applied to the developing world. The foundation of ICTs consists of developed countries' cultural hegemony, knowledge, and ideas (van Grasdorff as referred to in Gudmundsdottir, 2010), and in this way, colonial ties are maintained (Gudmundsdottir, 2010). Fuchs and Horak (2008) argued that such practices are an important contributor towards Africa's current position in the digital divide; they contended that applying Western technologies to developing countries is a form of cultural imperialism in which local and traditional solutions and strategies are neglected. Further, they posited that "the effect of hundreds of years of colonial and post-colonial exploitation, exclusion, and dependency on the Third World…has caused the very conditions that Africans have to face today" (p. 115).

Thus in applying postcolonial theory to the issue of using ICTs in higher education in Africa, it is suggested that the importance of Africans' indigenous needs and culture should be taken into account in these initiatives and that these initiatives should be developed and implemented by Africans themselves. Indeed, Gebremichael and Jackson (2006) posited that involving African communities and government in this process is essential for the initiatives' success.

To emphasize the significance of technological advancement for higher education in Africa, several scholars have suggested various strategies and considerations for promoting and analyzing how education can be carried on in Africa within the context of technology, using ICTs. Four salient components related to incorporating ICT into Africa's higher education system are discussed below: (a) teacher education (McCann et al., 1998; Stevens, n.d.); (b) curriculum (Alaneme, 2010; Shrestha, 1999); (c) distance learning (Brown, 2003; Nwaboku, 1997; Shrestha, 1999); and (d) educational policy, planning, and management (Brown, 2003; Butcher, 2009; Shrestha, 1999; Yapi, 1997).

Teacher Education

Most African educators have little interest or experience in using ICTs (Unwin et al., 2010), therefore staff education/training in obtaining experience and skills with ICTs (McCann et al., 1998), particularly in the organization and structuring of educators' teaching materials (Unwin et al., 2010), is needed to pique their

interest and educate them on the potential that ICTs hold for higher education. Such training will result in a mix of technical, vocational, and academically trained personnel as a strategy for improving efforts to incorporate technology into African higher education. Educators should also be taught the knowledge and skills they need to maintain and modify ICTs (Gebremichael & Jackson, 2006) so that they can adapt the technology for different purposes and have the knowledge and skills to develop local ICT content that take into account the needs and culture of Africans.

There must also be best practices in training to update the staff's ICT skills (Stevens, n.d.). Such best practices entail providing teachers with basic skills in ICT use, followed by fostering competencies in social and technical issues, pedagogy, collaboration, and networking (UNESCO, 2002), and incorporating the themes of "context and culture, leadership and vision, lifelong learning, and the planning and management of change" (Unwin, 2005, p. 115). It is believed that by providing educators with ICT training and directly involving them in ICT initiatives, these initiatives may be more likely to succeed (Unwin, 2005). Programs suffer from a severe shortage of staff, with many institutions operating from the stance of "one-person bands." There are too few institutions with technology, and there is even a shortage of staff who have been educated in its use and potential, limiting the opportunity for research and development of ICTs in higher education.

Curriculum Development

In an interview with Dr. Kelvin Urama, Executive Director of the African Technology Policy Studies Networks, based in Nairobi, Kenya, Alaneme (2010) questioned him about how to develop curriculum in the interest of better educating students of higher education. They talked briefly together about the need for not only curriculum change in Africa, but also a change in the African mindset regarding what is "good science"— a mindset that integrates science, technology, and innovation together. Dr. Urama posited,

> If we begin to change these fundamental concepts, the pedagogy we have and then the system of teaching and learning we have, then we will be able to start evolving the new science that we want for Africa, the new types of technology we want for Africa and the new type of innovation that we also need. (as cited in Alaneme, 2010, p. 2)

Dr. Urama explained that African higher education needs to start this process of change with a focus on building capacity: building capacity to create a core of scientists who understand science for development, technology experts who understand technology for development, and innovators who can transform science to the field. Reflecting a postcolonial–critical pedagogy theoretical perspective, Dr. Urama emphasized, "Science, technology, and innovation are meaningless if they cannot solve local problems" (as cited in Alaneme, 2010, p. 1)—the actual needs of the people of Africa. Accordingly, the change that is needed in the curriculum of higher education should reflect this mindset, in contrast to the present focus on production of research and an over-emphasis on certificates, reminiscent of a past colonial mindset. Overall, the rationale behind capacity building through an integration of science, technology, and innovation is grounded in a postcolonial theory-critical pedagogy perspective. The rationale is to design a curriculum for Africa that will ultimately impact both the market and care of the poor—a curriculum that will help learners change and improve their own lives and that of their local communities, as well as the welfare of their country.

Curriculum underpins much of the content of the various courses with regard to the number of variations both within the technology components of the courses and in the number and variety of ancillary courses, as well as those related to educational theory and methodology offered (Alaneme, 2010; Shreatha, 1999). In addition, the governance structures (e.g., the Ministry of Education, the Ministry of Agriculture, the Ministry of Finance, and the Ministry of Science and Technology) must work together in order to achieve the common goal of development, according to Dr. Urama, who concluded his interview with Alaneme (2010) with the motto

of the African Technology Policy Network: "Building African science, technology and innovation today for sustainable development for tomorrow" (as cited in Alaneme, 2010, p. 2).

Distance Education as a Learning Technology.

Africa has been a fertile ground for the growth of open universities, independent distance education institutions, and a variety of technologically based programs and projects within universities. Institutions and projects in Africa established in the past are still actively promoting technologies of various kinds and combinations as a means of enhancing existing programming and fulfilling different existent educational objectives (Shrestha, 1999).

It is unfortunate that a number of the past technological innovations that were put in place have not been sustained. External aid packages played a crucial role in the establishment of some of these technologies, but in many cases, the need for the provision/supply of local experts was not given the due consideration it deserved (Nwaboku, 1997). In such circumstances, a number of technological programs, initiated with enthusiasm in the past, lost their momentum and were unable to survive. Another contributing factor is a lack of partnership and communication between African governments, international agencies, the private sector, and civil society organizations, which has led to a lack of coordination and duplication of efforts in implementing ICTs (Unwin, 2005).

Nevertheless, in spite of earlier technological failures of the old system, new technologies, and in particular, the computer and networking technologies "have, by creating conditions for rapid connections, opened up possibilities for many different educational and learning opportunities" (Sthretha, 1999, p. 6). For example, ICTs can help distance learners effectively learn at their chosen level and encourage them to understand course material through new modes (Unwin, 2005). Unfortunately, despite decades of development efforts, "the education situation at "the tertiary level has been deteriorating rapidly," according to Sthretha (1999, p. 7), and the nature and quality of education across the continent in terms of educational access and opportunity, particularly for the majority of people in Sub-Saharan Africa, have not improved (Shrestha, 1999) as compared to Asia and other continents.

Institutions of higher learning must offer both in-service and pre-service programs to respond to the critical shortages regarding needs of technology (Unwin, 2005). "The mixing of distance learning with mobile telephony to produce m-learning will provide the future of learning" (Keegan as cited in Brown, 2003, p. 7), and this is an area upon which the Africans are intensively focusing. Brown (2003) provided an example of a m-learning project in Africa, undertaken by the University of Pretoria, which began using mobile phone support during 2002 in three programs of the Faculty of Education to promote technology in this department. Text messaging was sent out to all participants in the project that related to such administrative support as reminders for exam registration, notification of distribution of study material, and other important scheduled activities. The advantages and successes of this project activity proved significant, and a follow-up workshop led to "a number of important action plans and recommendations for m-learning" (p. 9) regarding enhanced possibilities for the use of mobile phones and text messaging not only for administrative support but also for academic purposes.

The rise of ICTs and internet connectivity. Yet, the good news is, "the adoption rate of mobile technologies in Africa's developing countries is among the highest rate globally" (Brown, 2003, p. 1) as compared to that of other developing countries in the world. Satellites, radios, desktop computers, and laptop computers are samples of the various channels of communication that have been used to deliver education and training, both on and off campus, for improving higher education, but are limited. Currently, Internet connections are possible over any kind of networking, such as dialing up on the telephone, digital and analog networks, satellites, radio, cellular phones, and public switched telephone networks.

Several countries on the African continent are familiar with different technologies introduced in the educational systems (Butcher, 2009; Ochieng, 2006; Shrestha, 1999). Studies have shown that educational radio and television programs have been used in many developing countries as a panacea for reaching learners in remote areas in making education accessible and affordable to the learning community. Therefore, technology used in distance education and learning has been a long-established tool in developing countries that has undergone a remarkable paradigm in its use in higher education (Potashnik & Capper, 1998; Shrestha, 1999).

Examples of technological initiatives in higher education. The use of ICTs in Africa for the purpose of education is widespread, with a number of initiatives and projects currently being undertaken (Isaacs, 2013) and new developments taking place across the continent every day (Farrell, Isaacs, & Trucano, 2007). Countries in all parts of Africa have established some form of connectivity to computer-based networking. Mozambique is an example of an African country that found a way to provide connectivity, despite few resources (human or financial) to support the early use of the Internet (Shrestha, 1999). However, with the exception of South Africa, "the computer communications in other countries do not have an installed base of commercial/university support system" (Shrestha, 1999, p. 8).

The Pan-African Development Information System (PADIS) is an example of a larger-scale initiative that seeks to connect African countries through electronic networking. Created in 1980, PADIS is an Ethiopian regional development information system currently in the process of installing networks in 24 African countries (Ali-Dinar, n.d.). In the context of higher education, "PADIS has been instrumental in the development of low-cost connectivity in numerous university departments in the region" (Shrestha, 1999, pp. 8-9). PADIS's other major goal is to promote policies concerning the adoption and use of ICTs, and it accomplishes this through working closely with the Economic Commission for Africa (Ali-Dinar, n.d.). PADIS also provides skills training on ICT methodologies, utilization, and policies to policy makers, staff, and system users through workshops and seminars (Ali-Dinar, n.d.).

Another successful initiative that has incorporated ICTs into higher education is the African Virtual University (AVU). Since its beginnings in 1997, AVU has established connections to 27 African countries and 53 institutions of higher education, and is currently the leading Pan-African e-learning network (AVU, 2012). AVU seeks to use ICTs to increase Africans' access to high quality education and training and accomplishes this through delivering degrees, diplomas, and certificates through ICTs, managing a digital library, developing African-based educational materials in multiple languages, and training staff in ICTs and e-learning methodologies (AVU, 2012). Thus, the above examples demonstrate that Internet connectivity is on the rise in African nations. However, it should be noted that accessibility exists only in urban areas (Shrestha, 1999).

Educational Policy, Planning, and Management

Effectively integrating technology into educational planning, policy, and management in higher education in Africa can assist in lowering technological illiteracy, as an obvious advantage. Matters concerned with educational policy, planning, and management require reliable as well as organized data and information upon which to rely in making effective decisions. For example, one important recommendation is that the International Institute for Capacity Building in Africa (IICBA) make a strong effort to "build or develop a comprehensive education database, preferably in partnership with groups such as the Africa Live Database at the World Bank and UNESCO divisions responsible for maintaining education sector database related to Africa" (Shrestha, 1999, p. 14). Such international databases hold a large amount of macro-economic and sectoral data. In most cases, education sector data usually include student enrollment by age, level, and gender; however, in order to construct an effective, comprehensive educational database, data on other vital educational performance indicators, such as the educational level of teachers, how much money is allocated to education, information on library facilities, and many other indicators, are needed—indicators that are seriously lacking in African higher education (Brown 2003; Shrestha, 1999). In short, IICBA has the potential, through partnerships, cooperation, and collaboration with other organizations, to contribute significantly by building databases useful for educational policy making, planning, and management.

Strategies for education, training, and learning as well as the premises for African higher education should face continuous examination, evaluation, and subsequent revision as needed. Lessons learned from proper mechanisms or pilot projects should be developed to encourage policy makers, planners, and managers who belong to various levels of administrative and functional chains to use or find new and/or creative ways of using technology training centers and laboratories for the purposes of learning (Brown 2003; Butcher, 2009; Shrestha, 1999).

Focus on Ghana, Kenya, and Tanzania

The focus of this section is on Ghana, Kenya, and Tanzania in terms of their ICT infrastructure and policies and their relevance to higher education. Practical considerations that impact ICT adoption and implementation are briefly discussed, and an example of an ICT initiative that is currently underway in each country is outlined. According to the World Economic Forum, *Global Information Technology Report 2005/06*, ICT infrastructure development has not progressed rapidly in Sub-Saharan Africa ("Ghana," n.d.); but as can be seen from the following discussion, progress is being made on various levels.

Ghana

The ICT infrastructure and connectivity in Ghana dates back to 1995, when Ghana became the second country in Sub-Saharan Africa to have full connectivity to the Internet ("Ghana," n.d.). The country is connected to the world's first submarine, fibre-optic cable system, SAT-3/WASC/SAFE, which links Africa to Europe and Asia, and is connected to a national fibre-optic network called the Voltacom Project (Opoku, 2004 as referred to in "Ghana," n.d.).

Although Ghana achieved full Internet connectivity in 1995, ICT development in the country can be considered to be in its infancy ("Ghana," n.d.). Indeed, ICT access is still unevenly distributed and inadequate throughout Ghana, particularly when comparing urban and rural ICT access (Mangesi, 2007). For example, telephone links to the rural areas are still very poor, despite recent advances in wireless telephone communications. Between 2000 and 2005, the number of fixed-line phones only increased from 206 to 323, while the number of mobile phone users increased from 222 to 2,472 (Ministry of Communications as referred to in "Ghana," n.d.). Whereas Internet access is increasing in Ghana, a basic factor limiting household access to the Internet is the expense involved. For example, "a typical web user has to pay a monthly subscription fee averaging US$30 for unlimited access and one email account, plus a telephone usage rate of at least US$0.03 per minute" (Ahiabenu as cited in "Ghana," n.d., p. 25). Even Ghana Telecom, the national carrier, which is expected to be a leader in ICT development, is struggling to meet these demands ("Ghana," n.d.).

Ghana has demonstrated a general commitment to using ICTs to improve the quality of education at the presidential and ministry levels, as can be demonstrated by the fact that education receives the highest amount of national budget resources (Mangesi, 2007). At the national level, Ghana passed the ICT for Accelerated Development (ICT4AD) policy in 2004, which addresses 14 areas of focus for ICT development (Mangesi, 2007). One of these areas is the promotion of ICTs in education, and this policy outlines clear strategies for achieving ICT growth in this area (Mangesi, 2007). However, coordination among all the agencies involved in implementing these policies has been poor (Mangesi, 2007).

In 2002, the Ghanaian Minister of Education spoke to policy makers on the importance of ICT in education, focusing on distance education as facilitated by technology. An excerpt from his presentation follows:

> ICT creates the opportunity for government to provide distance-learning programmes which make it possible for many more people, located far from the centre of learning, to educate themselves. With the inability of the country's public universities to admit about 60 per cent of qualified applicants each year due to inadequate infrastructure and teaching personnel, an efficient use of ICT in education would be an important asset for the promotion of distance education in all educational institutions. (as cited in "Ghana," n.d., p. 33)

The use of ICTs is most advanced in Ghana's tertiary education system (Mangesi, 2007). The higher education system consists of universities, university colleges, professional institutes, preservice training institutes, and polytechnics (Mangesi, 2007). All of the major universities have ICT policies, including an ICT charge for students that enables them to have access to computer labs with internet connections (Mangesi, 2007). Nevertheless, "having Internet connectivity is one thing, maximizing utilization of the tool is another" (Boaffo-Arthur, 2006 as cited in "Ghana," n.d., p. 30). In order to address this issue, the Global e-Schools and Communities Initiative (GESCI) is currently collaborating with the Ghanaian Ministry of Education to help them "expand the deployment of ICTs in schools in Ghana and to promote the effective use of these ICTs to achieve Ghana's educational and community development objectives" (Mangesi, 2007, p. 6).

Although government attitudes about the use of ICTs in education are positive, these attitudes are less positive among educators and administrators (Mangesi, 2007). This may be partially due to this group's lack of exposure to and skills with ICTs (Butcher, 2009), which results in uncertainty and fear (Unwin, 2005). Indeed, it is well established that many lecturers are not familiar with computer technology, and some are not even able to use the Internet for basic e-mail communications due to a lack of formal training, inadequate access to computers, and the unavailability of Internet connectivity ("Ghana," n.d.). If teachers do not have ICT skills themselves, then they will experience difficulty transmitting these skills to their students and integrating the use of ICTs into their teaching. On the other hand, some teachers with some ICT skills are using the internet for research purposes, and smart boards and projectors are also in use in some Ghanaian schools (Mangesi, 2007).

Another major challenge in the development and implementation of ICTs in the Ghanaian education system is "brain drain" (Intsiful, Okyere, & Osae, 2003 as referred to in "Ghana," n.d.). The most talented people in the field of science and technology have either left Ghana for more attractive opportunities elsewhere or are seeking careers in the private sector of the economy (Intsiful et al., 2003 as referred to in "Ghana," n.d.). This has resulted in a lack of ICT engineers and scientists who are competent in understanding ICT-related projects on a professional level, which will hinder the growth of ICTs in Ghana. Overall, although there has been enormous investment in the country's ICT infrastructure as well as ICT capacity building, Ghana is still "largely isolated digitally from the Global Village because it lacks the critical drive and strategies to harness the full potential of ICT for the socio-economic development of the country" (Frempong, 2004 as cited in "Ghana," n.d., p. 25).

Kenya

During the 1970s, Kenya's infrastructure was considered one of the best in Africa; however, mainly due to lack of donor funding and government corruption, this is no longer the case (OECD as referred to in "Kenya," n.d.). Access to electricity is limited, as are phone lines (Farrell 2007). For example, fixed-line phones numbered 281,800 in 2005, whereas mobile/cellular phones numbered 4,612,0000 in 2006; Internet users numbered 200,000 in 2000, increasing to 1.05 million in 2006; and Internet hosts numbered 13,724 in 2001 (Farrell, 2007). And although many Kenyans own mobile phones and use the internet at access centers and internet cafés, few own a home computer (Farrell, 2007).

The National ICT Policy was developed in 2006 with the goal of ensuring that ICT services are available, reliable, and affordable to Kenyans (Farrell, 2007). Currently, the government of Kenya, through ICTs, is making efforts to introduce electricity in rural areas to help equip primary and secondary schools with computers and the Internet ("Kenya," n.d.). In addition, this policy includes a section on ICTs and education, the objective of which is to foster the use of ICTs in educational settings in order to improve teaching and learning quality (Farrell, 2007). This objective was deemed to be a national priority by the Ministry of Education, leading to the development and implementation of the National ICT Policy for Education and Training in 2006 (Farrell, 2007).

All Kenyan universities have an ICT policy, but they struggle to implement these policies due to a lack of resources (Farrell, 2007). The Kenya Education Network (KENET) strives to aid in the integration of ICTs in education by providing fast, reliable, and more affordable ICT services to Kenyan educational institutions

(Farrell, 2007; KENET, 2014). This initiative plans to install permanent infrastructure for high-speed internet access and node infrastructure for a number of educational institutions over the next two years (Farrell, 2007). Members of KENET also receive access to staff training and technical support services (Farrell, 2007).

Despite this fact, e-learning is beginning to take a prominent place in Kenya, particularly because it allows many more students to access education, both on campus and through distance learning ("Kenya," n.d.). This is of particular importance in Kenya given the fact that in 2006, of the 68,000 students who qualified for entry to the public universities, 58,000 failed to gain admission, primarily due to the competitiveness among institutions as well as considerations of financial availability (Otieno & Ngolovoi as referred to in "Kenya," n.d.). All of the public universities offer distance learning programs, whereas only two private universities offer this form of learning ("Kenya," n.d.). E-learning via the use of ICTs encompasses a wide range of activities, from supported/traditional learning to solely on-line learning to a combination of the two—blended learning. Moreover, in regard to use in distance learning programs, e-learning is conducted via mobile phones, CD-ROMs, video conferencing, interactive TV, e-mail, websites, satellite broadcasts, and Internet usage (Gunga & Ricketts, 2006 as referred to in "Kenya," n.d.).

Some of the African universities offer virtual learning environments (VLEs) as a way of collaborating in the area of content development as well in terms of delivery practice (Gunga & Ricketts, 2006 as referred to in "Kenya," n.d.). A good example of this in Kenya, as mentioned earlier, is the African Virtual University (AVU), whose main goal is "to promote and support initiatives in open, distance, and electronic learning (ODEL) in Africa" (Dzvimbo as referred to in "Kenya," n.d., p. 45).

Some scholars have warned that there are obstacles to the implementation of ICT in Kenyan higher education, such as "low initial capital investment, inadequate budgets for development and recruitment expenditures, and weak ICT infrastructure, especially in rural areas" (Ndege as cited in "Kenya," n.d., p. 45). In order to address funding issues, partnerships must be developed to help secure funding for computer equipment, installation, and maintenance, as well as Internet connectivity. Additional obstacles include unreliable and expensive internet access costs and a lack of ICT access and experience, leading to poor ICT skills (Farrell, 2007). In order to address these issues, teachers and senior education officials must be provided with ICT training. Therefore it is necessary for public universities to evaluate the costs of various technology choices in order to make informed decisions about how to implement ICTs in higher education in a practical manner.

In sum, there is great potential for the use of ICTs in Kenya due to high demand for higher education and the country's current inability to meet this demand. Distance education and higher learning are potential solutions to this growing problem, however their development and implementation must take into account the country's financial and infrastructural constraints in order for these forms of learning to be successfully integrated into the current education system. Initiatives such as KENET hold great promise in the increased use and adoption of ICTs in Kenya's education system.

Tanzania

The ICT infrastructure of the United Republic of Tanzania is in the early stages of development, however it has "accelerated recently from being insufficient and unreliable to being 'a fair system operating below capacity and being modernized for better service,'" according to the CIA (as cited in "Tanzania," n.d., p. 119). In addition, in 2003, Tanzania adopted a national policy that recognized that developing infrastructure is crucial in the country's development and use of ICTs (Hare, 2007). The use and adoption of ICTs in the country has steadily increased since the mid-1980s, when the country's ban on TV and computers was lifted (Hare, 2007). For example, in 1999, it was estimated that only 25,000 people were frequently using the Internet, whereas by 2006, that number had skyrocketed to 300,000 ("Tanzania," n.d.). However in terms of telecommunications, Tanzania only had one telephone line per 100 people in 2003, below the rate of neighboring countries, such as Zambia and Kenya ("Tanzania," n.d.). Consequently, access to telecommunications is primarily by means of public phones or borrowed cell phones ("Tanzania," n.d.).

Nevertheless, it is assumed that the continued rapid growth in the use of digital devices in Tanzania will result in making ICTs increasingly accessible to the average Tanzanian.

The use of ICTs in Tanzania's education system had its beginnings in the late 1960s, when schools used radios to provide students with educational audio programs designed by the Ministry of Education (Hare, 2007). New ICT initiatives in 2002 helped raise awareness of the advantages of using ICTs in education and led to ICT being a priority in planning education (Hare, 2007). In terms of ICT policies, the ICT Policy for Basic Education, the Education and Training Policy of 1995, the Primary Education and Development Plan 2002-2006, and the Secondary Education Development Plan 2004-2009 reference ICTs under the need to increase access and improve education quality (Hare, 2007). However the absence of a policy framework has posed a challenge to the use of ICTs in education in this country (Hare, 2007).

Another hindrance to the adoption of ICTs in Tanzania is the fact that ICTs are in English, and the majority of the population is more comfortable with the Kiswahili language (Hare, 2007). As a result, there is burgeoning interest in developing content in the native language through the use of open source software (Hare, 2007). The high cost of owning ICT infrastructure is another hindrance in ICTs' widespread adoption (Hare, 2007). Further, most schools are located in rural areas, but these schools are not connected to the national electricity grid (Hare, 2007). Thus, it is not surprising that ICTs are currently being used mostly in urban private secondary schools (Hare, 2007). Moreover, their use has currently been limited to the administrative level rather than to the enhancing of teaching practices (Hare, 2007).

Most universities have dedicated computers ("Tanzania," n.d.). For example, in terms of equipment, the largest university, University of Dar es Salaam (UDSM), has facilities for videoconferencing and 300 computers for staff and students (Tanzania," n.d.). UDSM also uses Blackboard, a digital learning environment that offers a variety of courses. Moreover, UDSM has launched initiatives related to teacher training, combined with a number of open-source projects ("Tanzania," n.d.). There is a proposal underway at UDSM to explore e-learning as a way to improve education in Tanzania. Although transformational policies at UDSM have been addressed, a 2007 report from the Carnegie-Mellon Foundation emphasized the need to "improve the teaching and learning process through staff training and acquisition of computer equipment" (as cited in "Tanzania," n.d., p. 127).

The Tanzanian universities have established various initiatives to explore and develop strategies aimed at improving teaching and learning with the use of technology. For example, the proposed eSchools Programme seeks to improve this situation over a 5-year period by "equip[ping] schools with ICT equipment (including access to the Internet), adopt[ing] educational management information systems at both the school and ministry level, and develop[ing] curriculum and online content for secondary schools" (Hare, 2007). This initiative has not yet been implemented; however a separate sector-wide ICT program is currently being implemented in teacher training colleges (Hare, 2007). This program seeks to use ICTs to improve teacher education at the pre- and in-service levels by equipping them with hardware, software, and internet access (Hare, 2007).

In sum, despite Tanzania's initial delay in the use and adoption of ICTs, the government's recognition of its potential utility has led to its increased use in recent years. However, without a policy framework, ICTs are still not being used to their full potential in the education system; and as a result, neither the students nor the teachers are fully benefiting from these technologies. Therefore there is a pressing need for universities to develop these policies in order to more effectively use ICTs and thus maximize the benefits they can provide. Nevertheless, based on rapidly increasing efforts related to development in infrastructure, it can be predicted that the quality of education in Tanzania's tertiary institutions will be increased or improved through the increased availability and use of ICTs ("Tanzania," n.d.).

Future Directions

Although numerous attempts have been made to narrow the digital divide in Africa, particularly in the higher education setting, it is a fact that many of these initiatives have failed. Therefore it is vitally important that African governments and policy makers consider the factors that foster and hinder the successful implementation of ICTs in Africa in order to improve current initiatives and/or develop new initiatives that are

more likely to succeed. Further, African governments must be aware of the colonial influences inherent in the adoption and use of ICTs. Ideally, developed countries' technologies should not simply be implanted into Africa countries with the purpose of meeting their needs (Gebremichael & Jackson, 2006). The countries of Africa must modify and eventually develop their own ICTs to meet the specific needs of their communities, lest a colonial environment be perpetuated through Western dominance over ICTs and culture in their countries (Gebremichael & Jackson, 2006).

The main factor that impedes the adoption and use of ICTs in higher education in Africa is infrastructural constraints. Without the infrastructure to support the use of ICTs, it will be impossible for African countries to implement these technologies and improve their education systems. Limited financial resources also play a major role in the lack of infrastructure to support ICTs. If a small portion of the governmental budget were to be devoted to establishing and maintaining this infrastructure, then small changes could lead to major gains. In addition, establishing partnerships with donors and agencies in the developed world can aid in the establishment of infrastructure, as well as the implementation of ICTs (Unwin, 2005). However, African governments must ensure that the needs of the targeted African community are assessed at the outset and that communities and governments are involved at all stages of the implementation process (Gebremichael & Jackson, 2006). If this is done, initiatives will more likely be implemented in a cost-effective manner (Gebremichael & Jackson, 2006), because governments are in the position to ensure that activities are coordinated and efforts are not duplicated (Unwin, 2005). Further, by obtaining community and governmental input, ICT initiatives will reflect the needs and culture of the people and not be steeped in colonialist values and ideas. Finally, more cost-effective options must be sought and utilized in the establishment of ICT infrastructure. For example, initiatives such as KENET are providing cheaper options for the establishment of ICT infrastructure.

Physical and human resources to support ICTs are also lacking in Africa. In terms of the former, African countries can take advantage of developed countries' recycling programs, where old computers are provided to developing countries (Gebremichael & Jackson, 2006). In this way, Africans will have a cost-effective method of obtaining and accessing computers and ICTs, even if they are considered to be obsolete to developed countries (Gebremichael & Jackson, 2006). In terms of human resources, educators need to develop ICT skills and experience in order to more effectively use and maintain ICT technology (Gebremichael & Jackson, 2006), as well as learn how ICTs can be used to enhance teaching practices (Unwin, 2005). Such training can be included in traditional teacher training. Once a handful of educators have developed these skills, they can pass down these skills to other educators, who can pass on these skills to even more educators, in a cascading manner (Unwin, 2005). Educators can then pass these skills on to students, and these skills will eventually be transmitted to the general community in a similar manner. This method of transmitting ICT skills ensures that educators and students are taught in a culturally-relevant manner and ensures that colonial dominance is not implicit in the teaching methods.

In terms of educational software, a number of options are available, many of which are cost-effective. For example, open-source software is free software that can be freely distributed to any individual (Fuchs & Burns, 2008). This software provides Africans with the opportunity to adapt the programs to meet the needs of the community (Fuchs & Burns, 2008), particularly by including local content in native languages (Gebremichael & Jackson, 2006; Unwin, 2005). This feature provides Africans with the ability to break free of Western colonialism by developing educational software that meets their specific needs, and in this way, decreasing their dependence on developed countries to provide them with a means to educate their citizens. Another potential solution, although a less cost-effective one, is learning management systems, such as Blackboard. Educators can use this program to provide distance education to part-time and distance learners, as well as organize and deliver course content in a locally intuitive way, provide access to freely available electronic resources, and provide opportunities for group learning (Unwin et al., 2010).

Conclusion

The potential for the widespread use of ICT and Internet technologies throughout the African continent shows significant signs of encouragement in promoting higher education through the incorporation of ICT strategies, representing a strong drive for the Africa of tomorrow in providing high quality education to its citizens. Salmi (2002) quoted Charles Darwin as saying, "It is not the strongest species that survive, nor the most intelligent, but the ones most responsive to changes" (p. 23). Essentially, it does not matter whether the developed countries are leading or not; African higher education has the high potential for catching up in the technological race.

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